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ABSTRACT

A debate about qualitative versus quantitative analysis has been waged in the scientific community for several years. A different set of parameters is suggested for this debate, and a logical transformation is outlined that makes the qualitative/quantitative distinction at the epistemological level a non-problem. While the strategy of induction has been well-developed and frequently used, the strategy of abduction is hardly recognized. If abduction, a more metaphoric reasoning, is accepted on a par with induction and deduction, a new logic--"AID" (Abduction, Induction, Deduction)--may enrich the scope of rationality. When logical space is expanded to include abductive logic, the use of metaphor becomes legitimate in inquiry. In an inductive/deductive world, the qualitative/quantitative distinction is of central importance. In an AID world, this distinction would lose its force as the central underlying distinction. An appreciation for horizontal as well as vertical inference would surface. It would no longer be necessary to think of paradigms strung out along a qualitative/quantitative continuum. An AID logic would establish a multi-epistemological setting for educational inquiry. A 39-item list of references is included. (SLD)

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THE QUALITATIVE-QUANTITATIVE DISTINCTION:

Logic, Paradigms, Play and Metaphor

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A Paper

Presented at the Annual Meeting

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THE QUALITATIVE-QUANTITATIVE DISTINCTION:
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The feature paper of this Symposium (Cziko, 1989), on the basis of five wide-ranging arguments, concludes that "qualitative descriptions" at both the micro and macro level of analysis are much more appropriate to educational inquiry than are "quantitative measures". In deriving this stance from his examination of the "upredictable if not indeterministic" nature of human behavior, Cziko provides further support for a position that is becoming hegemonic in its own right.

The qualitative-quantitative debate that has raged over the past decade was essentially concerned with two issues: (1) At the level of paradigms (Kuhn 1962) the "purists" (e.g. Guba 1987, Smith 1983, Smith & Heshusius 1986, Tuthill & Ashton 1983) argued that the qualitative and quantitative approaches are "incommensurable" ("incompatible") and like Cziko usually supported the legitimacy of the qualitative paradigm; and (2) the "pragmatists" (e.g., Howe 1988, Miles & Huberman 1984, Herriot & Firestone 1983, LeCompte & Goetz 1982) argued that debate at the paradigmatic level was unnecessary if not misleading and instead tried to demonstrate through example studies that at the level of procedure, qualitative and quantitative methods could be effectively blended together in the same study. This debate still rages. It seems now to be reduced to a stalemate with one side (the pragmatists) claiming it is over, and the other (the purists) still maintaining that fundamental incompatibilities must be addressed. It is likely that this debate, given its present parameters, will never be resolved; it may only dissipate over time.

In this paper we would like to suggest a different set of parameters of a logical nature for the qualitative-quantitative debate. Within this alternate domain, the debate may be seen as a nonproblem resulting from a confusion in logical space. We wish to show that the debate is merely an artifact of being conducted within a logical space too restricted to allow resolution. If the logical space remains unchanged we suggest that this debate is likely to go on forever without any resolution. It is our intent to outline such a logical transformation and to argue that within such a transformed space, the qualitative-quantitative distinction, at the epistemological level, becomes nonproblematic.

LOGIC IN RESEARCH: THE 'RECEIVED' VERSION

Before turning to an alternate logic, let us briefly review and characterize the current received version.

When a theory (T) is to be tested, some empirical event (E) is derived from T in the following form: If T is true, E will be observed. On this basis, if E is not observed T is falsified; if E is observed, T is corroborated ('corroboration' is the term associated with Popper; others prefer the more positive term 'confirmation'). These two possibilitites (falsification and corroboration) are based on fundamentally different logics. The corroboration schema (often called the 'inductivist' schema) goes as follows:

SCHEMA I (Induction-corroboration)

```
Premise 1:   T -> E
Premise 2:   E
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Conclusion:  T
```

Although this schema seems commonsensical it is logically invalid: Both Premises can be true and yet the conclusion false. As pointed out so cogently by David Hume, a theory may undergo extensive corroboration perhaps over decades and still prove to be false. In simple terms, induction cannot lead to certainty. No matter how this case is dressed up with powerful statistical techniques and other inductive niceties, the problem of its invalidity remains intractable (Putnam, 1975).

Fortunately, a simple logical transformation upon this schema can produce some interesting possibilities: In elementary logic we find the principle that if P implies Q, then not Q implies not P. This is the Law of Contraposition. It can be used here as follows. Since T implies E (Premise 1), then by Contraposition not E implies not T. Thus, if we fail to observe E then we must reject T. This is the logic underlying the schema for falsification:

SCHEMA II (Deduction-falsification)

```
Premise 1:   T -> E
Premise 2:   not  E
-------------------
Conclusion:  not  T
```

Schema II forms the logical cornerstone of Popper's widely recognized treatise on "conjectures and refutations." Unlike Schema I, this Schema is logically valid. But it has serious limitations, the most obvious of which is that its validity is restricted to conclusions about falsity: Like Schema I, this Schema can never establish the truth of T; at best, and only over the long haul, it can identify a T which may survive several attempts at falsification. This is why Popper was so careful in talking about "corroboration" rather than "verification": He was keenly sensitive to the fact that the logical validity of Schema II does not extend to verification, and strictly speaking he is not entitled to use the word "corroboration" (see for example Putnam, 1974). In Popper's own words (1968:54-55) "Only the falsity of the theory can be inferred from empirical evidence, and this inference is a purely deductive one." This limitation of Schema II turns out to be even more debilitating in practice (see Garrison, 1986 or Lakatos, 1970, and particularly Hempel's (1946) "Paradox of the Ravens" and the voluminous literature it gave rise to).

In the philosophy of science it has become standard practice to associate deduction with what is termed the "context of justification" and induction with the "context of discovery". The rigor of science is then seen to be founded upon the bedrock of deduction whereas the "creativity" of science is relegated to the inductive processes of concept formation more properly seen as an aspect of psychology. In this view, induction is important only as a source of theoretic notions and relationships which must at some point be tested deductively within the context of justification. Rationality is therefore determined by a-cycling of inductive-deductive logic (see Hanson 1970 for some insightful alternatives).

The reduction of logic to the dichotomy of deduction-induction has unwittingly placed science into two modes: The context of justification has become associated with "quantitative method" whereas "qualitative method" has become associated with the context of discovery. In this way research methodologies can be placed on a continuum depending upon the degree to which either deductive justification or inductive discovery is seen as significant. At one end of the continuum would be experimental and quasi-experiemental designs, in the center would be various forms of ethnographic studies, and at the other end would be narrative/critical studies. The logic involved is still some variation on inductive/deductive thinking.

Within natural science, the reduction of rationality to deductive/inductive thought can be seen in Kuhn's historical analysis of science as proceding in cycles of "normal science" and "revolutionary science" where normal science is the result of a major emphasis on the context of justification (deduction) whereas revolutionary science is the result of a major emphasis on the context of discovery (induction). Indeed, the discoveries may be so major as to cast serious doubt upon the premises and practices taken for granted in more normal times. Kuhn used the term "paradigm" to refer to all the contextual premises and practices that are taken for granted during routine deduction, and "paradigm shift" to refer to the explict and implicit transformation of these contextual givens when inductively formed concepts of inescapable presence seem to indicate incompatabilities that cannot be ignored. Such transformations may be so awesome as to render the new paradigm "incommensurable" with the old one. As a particularly relevant case in point, if the recent trend to qualitative methods is seen as a paradigm shift, and if we accept Kuhn's notion of incommensurability, then there is no reason for those practising within the qualitative paradigm to pay any attention whatsoever to those practising within the quantitative paradigm, and vice versa. This is essentially the "purists" position.

Our critical claim is that the cycle of normal science and revolutionary science observed by Kuhn has been determined by the tacit acceptance of logic as consisting of two forms, deductive and inductive. Our critical hypothesis is that, had the received version of logic been different, Kuhn's historical analysis would have been different. In this paper, we should like to indicate a different logic and suggest that should this logic become pervasive, science would not only be practiced differently, the qualitative-quantitative dichotomy would become a trivial distinction of mere passing interest which, as history would have it, flared briefly in educational inquiry in the second half of the 20th century, but disappeared when a different logic gained recognition.

TOWARD ALTERNATIVE LOGIC

Long ago, C. S. Peirce wrote about what he called "abduction." In recent years there has been a mild resurgence of interest in abduction (e.g., Apel 1981, 1987, Cunningham 1988, Fann 1970, Gill 1986, Hanson 1970, Harris & Hoover 1983, Curd 1980, Hintikka 1983, Rorty 1979, Sawada 1989, Shank in press) but in this paper we return to Peirce's original contribution.

Peirce's notion of abduction evolved over a span of fifty years; understandably, his thoughts and writings on abduction exhibit at times a lack of consistency (most commentators have noticed this). However, his later writings (after 1891, and particularly after 1910) are remarkably clear on abduction and its significance in his thinking. Nevertheless, current scientific inquiry is modelled on the bi-polar logic of deduction and induction. It was Peirce's genious to see that science could not be contained within this logical bipolarity; induction and deduction were not the only logical processes involved in rational thought. This is in stark contrast with Popper who would go so far as to insist that deduction alone is sufficient, and it goes without saying that Popper's thinking is quite pervasive in educational research. Peirce's logic has been overlooked. To get a clearer idea of abduction and its relation to deduction and induction the syllogism, as Peirece used it, is invaluable.

A syllogism has three terms: a major premise, a minor premise, and a conclusion. Peirce called these the rule (Ru), the case (Ca), and the result (Re) respectively. Structurally, in a syllogism two premises are mapped onto a conclusion. In ordered pair notation: ((Ru,Ca),Re). The validity of the syllogism remains invariant when the order of the premises is interchanged, ie., ((Ru,Ca),Re) = ((Ca,Ru),Re). Given this transformation, there are precisely three distinct syllogistic schemas each defined by having either the Result, the Rule or the Case in the third position and each 'paradigmatic' of a particular logic. Each is illustrated below using Socrates.

Schema III: Deduction

```
Rule:      Humans die
Case:      Socrates is Human
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Result:    Socrates dies (eventually)
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Schema III is an example of valid thought and pervades our everyday thinking: A rule is applied to a particular case giving rise to a result.

Schema IV: Induction

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Case:      Socrates is Human
Result:    Socrates dies
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Rule:      Humans die
```

Schema V is an example of invalid logical thought although we do tend to use it to make "guesses" at what might be generalizable patterns. Here we have a case of a human (Socrates) who dies and from this result we try to generalize to the population (Rule). However, as noted earlier, Hume conclusively showed a long time ago that this logic can lead to false generalizations.

Schema V: Abduction

Result:	Socrates dies
Rule:	Humans die
Case:	Socrates is Human

In this syllogism we arrive at a Case: Socrates as a particular case of humanity. In a more realistic example, we might do an indepth case study of Socrates in order to understand what it means to be a teacher. In doing this study, Schema V tells us that we must not loose sight of the abductive intention: that Socrates is to be developed as a case of something (Socrates as a Teacher), not just a collection of thick descriptions leading to generalizations (inductive rules). Shulman (1986) stresses this point. Nevertheless, abduction and induction are often confused one with the other (Peirce himself was often guilty of this confusion as late as 1910). Indeed, as Harris & Hoover (1983) point out, this confusion is widespread among present day philosopers and scientists. As a case in point, they indicate that through his theory of abduction Peirce had anticipated a hundred years earlier Nelson Goodman's (1965) "New Riddle of Induction": The newness of Goodman's "New Riddle" largely disappears when abduction is brought into the discussion. This is highly significant because Goodman's "New Riddle of Induction" has, despite its relative recency, acquired the status of a 'classic' in philosophy. Abduction has indeed gone unrecognized!

Why has inductive logic become so widespread (in both quantitative and qualitative work) whereas abductive logic is almost unknown? In part because the "Logic of Discovery" has been totally ignored since positivistic times and in part because induction results in a Rule, whereas abduction leads 'only' to a Case. A Case is often seen as a much more limited claim than a Rule. However, with the recent resurgence of qualitative method in educational inquiry, Case Study has become popular. It is all the more significant, therefore, that induction and abduction be clearly distinguished. For example, researchers involved in case studies often feel the need to generalize (to a Rule); that if they don't come up with a generalization they haven't contributed to knowledge.

We suggest that they are driven in this way simply because their research paradigm (without their knowing it) is entrapped in inductive logic. If abduction were accepted as integral to rational thought, researchers doing Case Study would feel no compulsion to defend "generalizability" or to apologize for not attaining it. Expecting generalizability is a symptom of having confused abduction with induction, a rather pervasive symptom (e.g., Herriott & Firestone, 1983). Evidence for this symptom is rampant in educational research; we need look no farther than the 'AERA Handbooks of Research on Teaching'. In the First Edition there are these remarks from Campbell & Stanley (1963:176-177) commenting upon the one-shot case study:

> Such studies have such a total absence of control as to be of almost no scientific value. . . . It seems well-nigh unethical at the present time to allow, as theses or dissertations in education, case studies of this nature.

These remarks may be dismissed as dated and blatantly positivistic in nature and certainly not representative of current thinking. Consider therefore

these remarks in the up-dated (1986) 3rd Edition of the same Handbook by Biddle & Anderson (1986:238) commenting on case study from the qualitative perspective:

> We rarely know whether or not its findings will generalize. Limited generalizability is the price paid.

It is clear that Biddle & Anderson see generalizability as a valid criterion for case study and that this criterion is seldom met. However, as Schema V shows, a Rule is not being induced; a Case in being abducted. With few exceptions (see Overholt & Stallings 1976 and Shank 1986), current thinking in the logic of educational research does not recognize this distinction.

If these criticisms are valid, then the methodology of Case Study is in dire need of rethinking. The process of 'abducting' a Case needs to be logically and procedurally worked out as a contribution to qualitative research methodology (Sawada 1989). As a special benefit, this will distinguish the logic of Case Study from the logic of ethnography which is taken as inductive (Martin, 1987) despite abductive insight from commentators such as Overholt & Stallings (1976).

The strategy of induction is well developed and well used (perhaps overly used); the strategy of abduction is hardly recognized and used confusedly. In a paper entitled "C. S. Peirce's 'First Real Discovery'" Hintikka (1983) develops a powerful case for the significance of abduction by recounting how Peirce distinguished "theorems" from "corollaries": theorems have high abductive significance; corollaries have none. Of course, theorems also are much more significant than corollaries: corollaries are mere deductive footnotes to theorems (normal science). In this sense abduction leads to creative discovery.

BRINGING ABDUCTIVE TERRITORY INTO VIEW

Consider the two syllogisms below modified from Bateson (1987:44):

Socratic Syllogism	Syllogism in Grass
All men die.	All men die.
Socrates is a man.	Grass dies.
Therefore Socrates will die.	Therefore Humans are Grass.

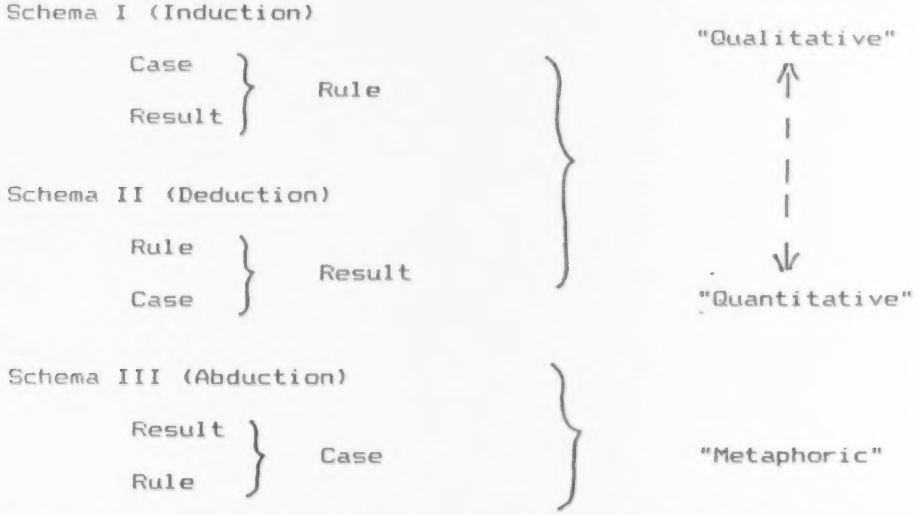
Although both arguments are here called syllogisms, the reader may find it difficult accepting the "Syllogism in Grass" as being rational. Even though it clearly has the form of a syllogism (a statement is derived as a conclusion from two statements taken as premises, the three statements being related in such a way that there are altogether just three terms (humans, grass, death), each of which occurs in two of the statements), and inspite of what has been said earlier in this paper, the argument likely appears irrational so powerful and pervasive is our acceptance of rationality as determined by induction-deduction. Indeed, anyone who is "taken in" by the "reasoning in grass" syllogism is said to be falling prey to the classical error of 'affirming the consequent'. Nevertheless, Bateson had this to say about the way of thinking in this syllogism (1987:45)

> And it seemed to me that indeed this was the way I did much of my thinking, and it also seemed to be the way the poets did their

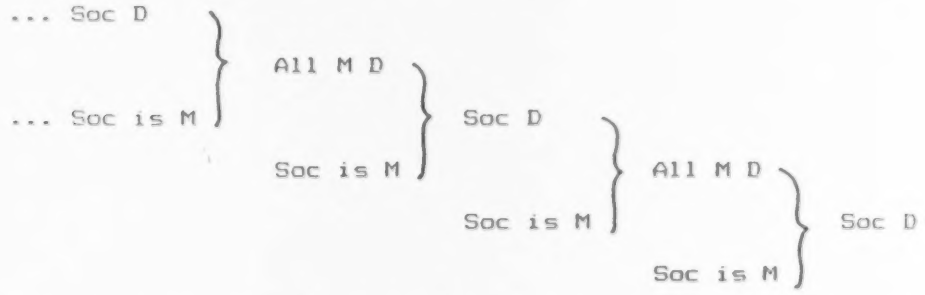
thinking. It also seemed to me to have another name, and its name was metaphor.

In this paper this kind of reasoning also has another name: abduction. If abduction (A) is accepted on par with induction (I) and deduction (D), then a new logic (AID) may enrich the scope of our rationality.

In schematic form what we have said so far can be iconically said as follows:

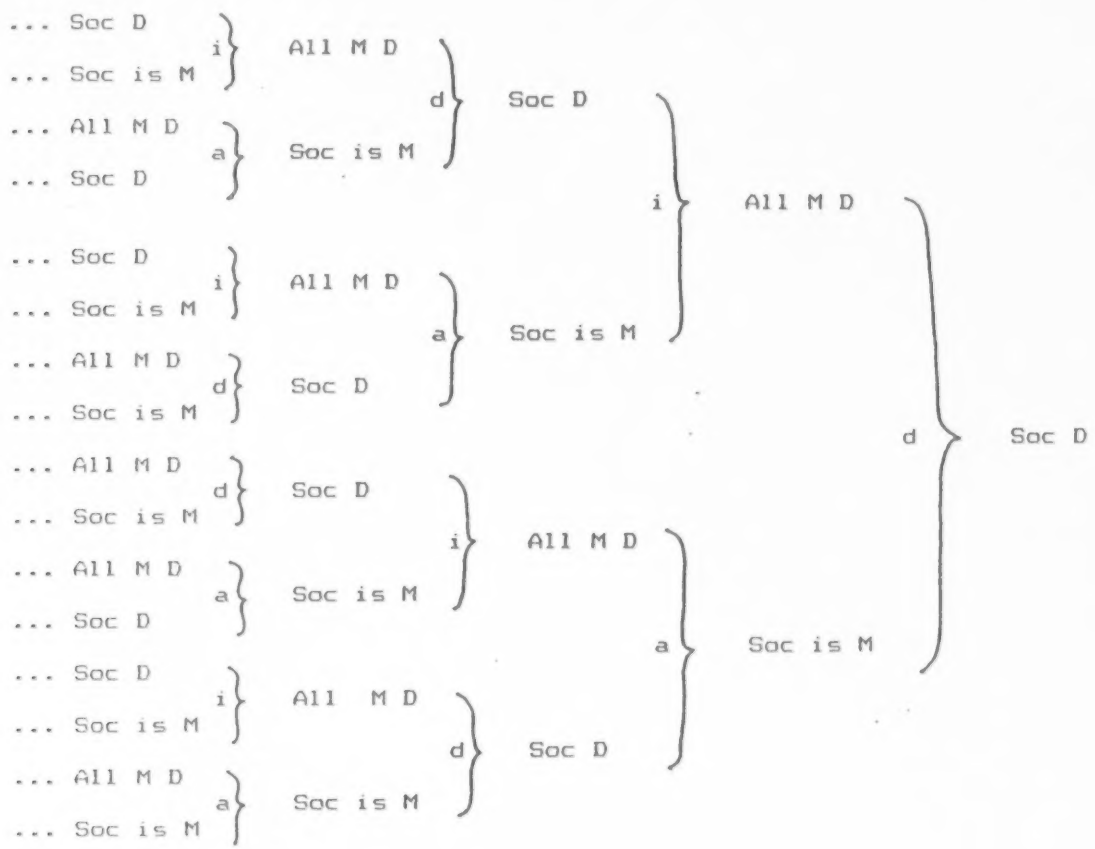


Let us use the bracket notation to bring abductive territory more clearly into view. The Socrates Syllogism can be given a logical "history" as a cyclical series of inductive/deductive implications resulting in the deductive conclusion that Socrates died:



From left to right, the first implication is inductive giving rise to the generalization that All Men Die. The second implication is a deduction resulting in the observation that Socrates died. The third is again inductive, and the next is deductive so on. Notice that in this cycling of induction/deduction, the realization that Socrates is a man is always <u>taken for granted.</u> He is merely a necessary appendage to the argument but always left dangling. Never examining Socrates' realization as a man, an historic and storyful entity, leaves the inductive/deductive cycle a somewhat unidimensional territory -- a logical "flatland", an "un-examined" life.

What is missing is the logical history which would imply that Socrates is a man. Such a history can be filled in with abductive implication [SD = Socrates Died; MD = All Men Die; SM = Socrates is a man]:



In this representation, the lower case a, i and d's indicate abduction, induction and deduction. The unidimensionality of ID space is seen to be but a linear reduction of the higher dimensional AID space. Moreover, while the above representation ends with a deduction, similar representations can be constructed which end with an abduction or with an induction. Playing with these "logical stories" can give rise to interesting explorations into AID territory and its particular revelance to case study and to narrative but perhaps it is enough here to simply indicate the nature of the "mindscape" (see Sawada, 1989 for other detail).

AID LOGIC THROUGH CREATIVITY, PLAY AND METAPHOR

In a remarkable little book published in 1987 entitled, "Science, Order, and Creativity" David Bohm and F. David Peat, both physicists argue that play is a fundamental activity in all science even though it has for too long been excluded as frivolous. In the context of Kuhn's notion of paradigms they suggest that while free play with ideas might be seen as appropriate during times of "revolutionary" science, such play is seen as distracting at best

during times of "normal" science. Then through examples drawn from the history of physics, they argue that failure to recognize playful ideas during "normal" science has led to unnecessary rigidity and fragmentation (Bohm & Peat 1987:39):

> A closer examination of the history of physics shows that a number of very powerful metaphors were developed during this period of "normal" science. Never pursued with sufficient energy and courage to initiate creative new discoveries, they were stifled by the weight of the whole tacit infrastructure of familiar and comfortable ideas that pervailed at the time.

We suggest that a central and pervasive piece of the infrastructure was the deductive-inductive cycle: deductive logic emphasized during "normal" science and inductive logic emphasized during "revolutionary" science. Within this dualistic logic it was almost inevitable that an historian of science would eventually describe scientific "progress" as occuring in major shifts, with each shift being somewhat incompatible (or at least different in major ways) with earlier inquiry. In times of major shifts, powerful new metaphors change the nature and direction of the disciplince. During normal science, metaphors are seen as unnecessary and distracting metalanguage. Normal science deals with "facts" not metaphorical fancy. Indeed, only in normal times are facts taken to be facts: During times of revolution facts are problematic precisely because the root metaphors that anchor the competing paradigms can no longer be taken for granted. Our point is that when logical space is expanded to include abductive logic then the use of powerful metaphors (and unpowerful ones too) is legitimate <u>at all times.</u> In this way, scientific progress would not be a matter of huge transformations after long periods of routine production. Indeed, the distinction between normal science and revolutionary science would, over time, become trivial. Creativity through metaphoric play would be abductively possible and appropriate at any time. Bohm & Peat (1987:48):

> Thought is generally considered to be a sober and weighty business. But here it is being suggested that creative play is an essential element in forming new hypotheses and ideas. Indeed, thought which tries to avoid play is in fact playing false with itself.

The falseness refered to by Bohm and Peat has another name: ignorance of or misreading of abduction.

However, the notion of paradigms would not necessarily disappear. Rather it is likely that there would be several paradigms co-existing at any given time, each seeking practioners but none necessarily dominating. An AID educational research world could be described as "poly-ontological" and "multi-epistemological". The work of Maruyama (1980) would likely be seen as a precursor to such a world describing as he does different epistemological "mindscapes" which encompass AID logic although his terminology differs (see Caley & Sawada (in press) for a collection of Maruyama's abductively oriented work). Dominance of any one paradigm or mindscape might be indicative of an homogeneity arrived at by unwittingly conducting inquiry under ID rationality rather than AID rationality. If a particular paradigm were to remain hegemonic over several generations, it would likely indicate a regression to ID space.

In an ID world, the qualitative-quantitative distinction is of central significance expressing as it does the ID dichotomy itself. Within an ID

world, the qualitative-quantitative debate was all but inevitable: Facts were of utmost significance, and the more precise (quantitative) the better. In such a world, qualitative facts would always have to strive for recognition.

In an AID world, to the extent that abduction opens up a whole new order of rationality, the qualitative-quantitative distinction loses its force as the central underlying disctinction. No longer would it be appropriate to think that all paradigms need to be strung out along a qualitative-quantitative continuum. While it would still be possible to do so, such a framing of paradigms would likely survive only as a pedagogical strategy rather than a research strategy.

Research that is pervaded by the thirdness of abduction would invite a metaphoric fabric of connectivity that all but banishes the qualitative-quantitative distinction as a fundamental duality in educational inquiry. Instead the richness of narrative and other forms of description would be as legitimate as any other. Thus rather than arguing that either qualitative or quantitative methods were more appropriate, an AID logic, in asserting an appreciation for horizontal as well as vertical inference, establishes and warrants a multi-epistemological setting for educational inquiry.

Let us close with a thought from Bohm & Peat (1987:61) with some parenthetical remarks inserted:

> The current mode of doing science has evolved in such a way that certain of its features seriously discourage creativity. Among these, one of the most important is the development of paradigms [e.g. qualitative paradigms to succeed the quantitative paradigms]. Clearly it is desirable at all times, and not merely during periods of scientific revolution, that there be the possibility of free play of the mind on fundamental questions so that a properly creative response is possible [AID logic invites such free play]. Paradigms, especially after they have been established for some time [e.g., the quantitative paradigm], hold the consusual mind in a "rut" requiring a revolution to escape from [the qualitative paradigm is now establishing a similar sort of rut]. Such excessive rigidity amounts to a kind of unconscious collusion, is which scientists unconscionusly "play false together" in order to "defend" the currently accepted bases of scientific research against perceptions of their inadequacy. [In an AID world, such collusion would neither be necessary nor would it even be appropiate. At the moment, however, such collusion pervades both the quantitative as well as the qualitative paradigms.]

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